

REMARKS/ARGUMENTS

Claims 1-8 and 10-13 are now in the application. Claims 1, 4, 8, and 12 have been amended. Claim 9 has been cancelled.

I. SUMMARY OF THE SEPTEMBER 30TH, 2003 OFFICE ACTION

A. Claim Objection

Claim 9 was objected to because of the following informalities: The Office Action states that claim 9 recites a line tangent to the circular edge being perpendicular to a line lying in the plane of the wafer. The Rejection further states that the tangent to the arc would be perpendicular a radius defining the arc and not to any line in the plane. This is not understood. Applicants have, therefore, cancelled claim 9 to avoid further confusion.

B. Section 103 Rejection

Claims 1-13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,432,620 to Arao in view of U.S. Patent 6,114,085 to Padmanaban et al.

II. THE REFERENCES

A. The Arao Reference

Arao U.S. Patent 6,432,620 teaches an edge rinse apparatus and an edge rinse method in which a swelling of an end portion of a resist produced by an edge rinse is eliminated. The resist coated on an unnecessary portion of the substrate is exposed and is developed by using the edge rinse apparatus including a substrate chuck for sucking and holding a substrate, a motor for rotating the substrate chuck, a nozzle for discharging a developing solution to a principal surface of the substrate, a nozzle for discharging the developing solution to a rear surface of the substrate, and an exposure means with the substrate chuck as a mask for the back surface of the substrate.

B. The Padmanaban et al. Reference

Padmanaban et al. U.S. Patent 6,114,085 discusses an antireflection coating composition, where the composition comprises a polymer, thermal acid generator, and a solvent composition. The patent further comprises processes for the use of such a composition in photolithography. The composition is said to strongly absorb radiation ranging from about 130 nm (nanometer) to about 250 nm.

III. THE INVENTION

The claimed invention comprises a process for forming a photoresist-free and ARC-free lip on the periphery of the upper surface of a semiconductor substrate adjacent the end edge of the substrate which comprises the steps of: forming an ARC layer on the upper surface of a semiconductor substrate, chemically treating the ARC layer to chemically terminate the ARC layer on the upper surface of the substrate a first distance from the end edge of the substrate, and to chemically form an uneven end edge on the ARC layer. A photoresist layer is then deposited over the semiconductor substrate and over the ARC layer thereon so that the photoresist layer completely covers the uneven end edge on the ARC layer. This step is then followed by development of the exposed peripheral portion of the photoresist layer to photolithographically terminate the photoresist layer a second distance from the end edge of the substrate. This second distance is smaller than the first distance, so that the chemically formed uneven end edge of the ARC layer remains covered by the photoresist layer. The exposed and developed end edge of the photoresist layer, unlike the end edge of the ARC layer, is a smooth accurate surface which does not lend itself to the formation of particles by subsequent engagement of such rough edges by substrate-engaging equipment.

IV. DISCUSSION

A. Introduction

Claims 1-13 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,432,620 to Arao in view of U.S. Patent 6,114,085 to Padmanaban et al. The Office Action states that the step of recessing photoresist from the edge of a wafer is known in the prior art, referring to Figure 9 (of Arao).

B. Irrelevance of Arao's Statements Regarding Dimensions of Photoresist Layers

The Rejection then states that in the edge band removal (EBR) process, the photoresist is exposed and developed at the edges of the wafer. The Office Action further says that the peripheral width recited by Arao (apparently portion 109) may range from 1-10 mm, depending upon the size of the substrate with a target value of 3.5 mm being preferred, and that this is within the ranges claimed for the resist.

Applicants note that the above statement in the Rejection "...this is within the ranges claimed for the resist." does not identify or recite any particular claim of Applicants. Since Applicants' invention relates to a relationship between the location of the respective end edges of Applicants' ARC layer (acknowledged by the Rejection on page 3, line 14, as not taught by Arao) and their photoresist layer, all of Applicants' claims recite a relationship between the "first distance" (the distance between the end edge of Applicants' ARC layer and the end edge of the substrate) and the "second distance" (the distance between the end edge of Applicants' resist layer and the end edge of the substrate).

Since the USPTO acknowledges that Arao does not teach an ARC layer beneath his resist layer, and all of Applicants' claims relate to a spacial relationship ("first" or "second" distance between the respective end edges of Applicants' ARC and resist layers and the end edge of their substrate), it follows that none of the teachings of Arao regarding dimensions of his resist layer

relate to Applicants' claims because Applicants' claimed values for their resist layer relate to their ARC layer which is stated by the USPTO to be absent from Arao.

C. Circular Versus Non-Circular Substrates

The Office Action, at page 3, lines 7-13, then discusses whether Arao's teachings regarding a non-circular substrate would apply to a circular substrate as well, referring to Applicants' claim 9. Since it is Applicants' position that their invention is not limited to circular substrates, and claim 9 (specifically referred to in the Office Action) has been cancelled, issues relating in particular to circular substrates would appear to be moot.

D. The Importance of the Absence of any Teachings or Suggestions by Arao or Padmanaban et al. to Use an ARC Layer in a Particular Spatial Relationship with a Photoresist Layer

The Rejection, at page 3, lines 14-17, then states that Arao does not teach that the underlayer is an ARC, but that ARC's are routinely used in photolithography, as readily verified by the teachings of Padmanaban et al. The Rejection says that Padmanaban et al. teaches the use of an ARC on a wafer and recessing the ARC by conventional EBR techniques, and then coating the photoresist *on top of the ARC and conventionally processed*.

There is no teaching or suggestion by Padmanaban et al. that there should be a special spatial relationship between the respective ARC and photoresist layers so that the rough outer edges of the ARC layer remaining after the chemical termination step, e.g., EBR step will be encapsulated by the photoresist layer. Such encapsulation, as taught and claimed by Applicants, results in isolation of the rough outer edges of the ARC layer from subsequent contact with processing equipment which could cause particle formation. Such protection from particle generation will be preserved, in accordance with the invention, during photoresist processing by using a special mask to permit photolithographic removal of a smaller amount of the photoresist layer, resulting in a second distance (the distance of the end edge of the photoresist layer to the

end edge of the substrate) smaller than the first distance (the distance of the end edge of the ARC layer to the end edge of the substrate). Such spatial positioning of the respective end edges of the ARC layer and the resist layer is neither suggested nor taught by the cited references. In the practice of Applicants' invention, not only will the uneven outer end edge of the ARC layer be isolated by its encapsulation by the photoresist layer, but the photoresist layer, by virtue of having been terminated photolithographically, will provide a smooth and accurate termination of the photoresist layer which is non-conductive of particle formation.

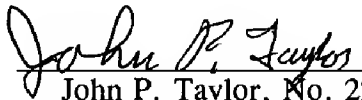
Appl. No. 09/997,071
Amendment dated December 22, 2003
Reply to Office Action of September 30, 2003

Docket No. 01-376

V. SUMMARY

All of Applicants' now pending claims should be patentable over the art. If the Examiner in charge of this case feels that there are any remaining unresolved issues in this case, the Examiner is urged to call the undersigned attorney at the below listed telephone number which is in the Pacific Coast Time Zone.

Respectfully Submitted,


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